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# The karyotype of *Makalata didelphoides* (Rodentia, Echimyidae)

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*Makalata didelphoides* is an echimyid rodent of arboricole habits, distributed east of the Rio Negro, north of the Amazon river including the Guianas and south of the Amazon from the Rio Xingu east-ward (Emmons 1993). Its karyotype, as in most species of the family, has not been previously described. Of the 55 species of Echimyidae recognized by Honacki et al. (1982), or between 60 and 100 species according to Emmons (1990), around 20 have been karyotypically analyzed. Known diploid numbers (2 n) in this family range from 14 to 118, and the fundamental numbers (FN, sex chromosomes not included) from 16 to 118; high 2 n and FN are frequent in arboricole species, against lower numbers in terrestrial species. *Echimys armatus* (I. Geoffroy, 1838) (= *M. didelphoides*) was placed in a separate genus, *Makalata*, by Husson (1978), a classification followed by Woods (1993) but not by Emmons (1990). *Makalata didelphoides* (Desmarest, 1817) is the oldest name for the red-nosed spiny rats currently known as *Makalata armata* as shown by Emmons (1993). One of us (AL), after examining the holotype at the Paris Museum, reached the same conclusion. The aim of this study was to describe the karyotype of *M. didelphoides* and to discuss the affinities of the species using karyologic information.

Studied specimens were provided by ELETRONORTE (the Amazonian electric company of Brazil). They were collected in 1987 as part of the animal rescue program "Operação Muiraquitã" at the time of the flooding of the Balbina Hydroelectric Dam on the Rio Uatumã, State of Amazonas. Four of the 20 specimens received, two males and two females, were karyotypically analyzed. Skins and skulls of these specimens were stored at the mammal collection of the Departamento de Sistemática e Ecologia of the Universidade Federal da Paraíba (Catalog numbers: UFPB 990, 958, 956, and 959).

Chromosome preparations were obtained from bone marrow by standard techniques (Baker et al. 1982). Slides were stained with conventional Giemsa staining; G and C banding were obtained following Seabrigt (1971) and Sumner (1972), respectively. A total of 20 metaphases were analyzed, approximately 5 for each specimen. Homologous chromosomes were identified by size, shape and G banding pattern.

In the four studied animals the diploid number was 66, and the fundamental number was 106 (Fig. 1). The karyotype contained 20 pairs of metacentric chromosomes varying gradually in size, one small submetacentric pair and 11 pairs of medium sized acrocentrics-subtelocentrics with a small size variation. The long arm of pair 11 showed a secondary constriction, which is a characteristic of the family Echimyidae. The X chromosome was a large subtelocentric and the Y chromosome was a small acrocentric. The pattern of G bands is shown in figure 2. C bands (Fig. 3) were restricted to pericentromeric regions. They were not evident in the large metacentric pairs 2, 3 and 4.

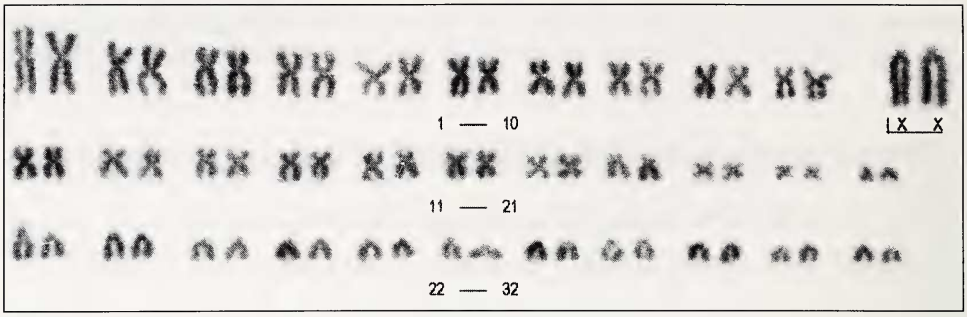


**Fig. 1.** Karyotype of female *Makalata didelphoides* (UFPB Nr. 956). Giemsa staining.

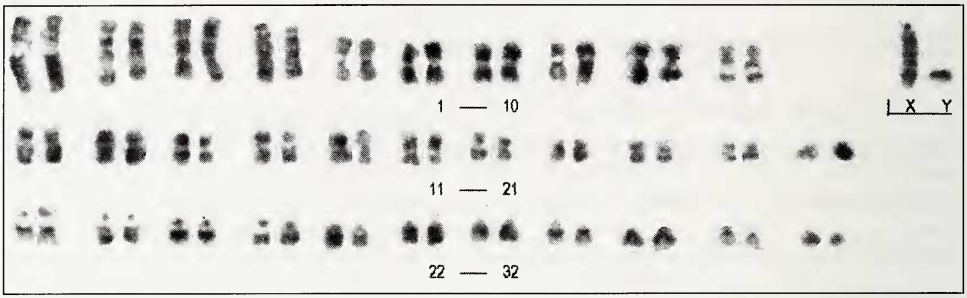


**Fig. 2.** G banded karyotype of male *Makalata didelphoides* (UFPB Nr. 990).

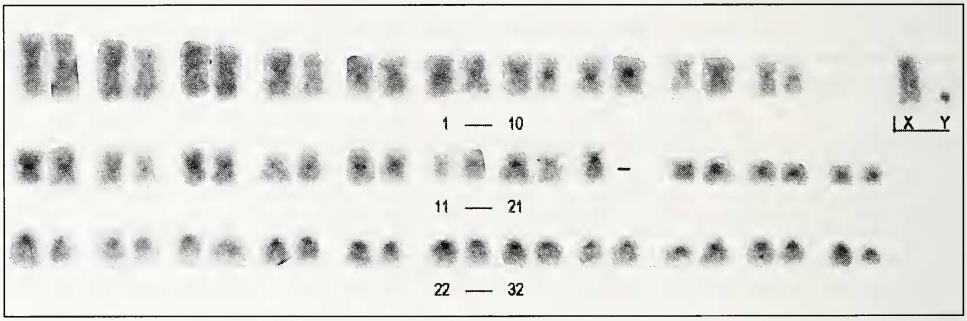


**Fig. 3.** C banded karyotype of male *Makalata didelphoides.* Same individual of figure 2, one chromosome of pair 18 is missing.

The karyotype of "*Makalata armata*" collected at Rio Jamari, Rondônia reported by Leal Mesquita (1991) (2 n = 70, FN = 120) differed substantially from the one here described. The specimen karyotyped by this author, deposited in the Museu de Zoologia, University of Saõ Paulo, (Nr. 27 446) is also morphologically different and belongs to a different species. Comparisons of diploid and fundamental numbers exclude simple Robertsonian mechanisms to account for these differences. More drastic karyological shuffling appears to be needed for explaining observed differences between our specimens and the one from Rio Jamari.

The karyotype of *Makalata didelphoides* shows a fundamental number within the range of most reported arboricole echimyids. *Echimys dasythrix* shows 2 n = 96, NF = 102 (I. Sbalqueiro pers. comm.); *Echimys* sp. 2 n = 90, FN = 108 (Yonenaga 1975); *Mesomys*

*hispidus* 2n = 60, FN = 120 (Leal Mesquita 1991); *Isothrix bistriata* from Rio Jamari 2n = 60, FN = 120 (Leal Mesquita 1991). However, *Isothrix pagurus* from Peru shows 2n = 54–58, and *Isothrix* sp. from Manaus 2n = 22, FN = 38 (Patton and Emmons 1985). J. L. Dunnum, J. Salazar-Bravo, and T. L. Yates reported in a study presented at the 76th Annual Meeting of the American Society of Mammalogists, 1996, (Abstract 111), a diploid number of 118 for *Dactylomys boliviensis*.

Variation in diploid number among arboreal echimyids appears to be higher than in fundamental number, suggesting that Robertsonian rearrangements might be significant in the karyological evolution of this group.

Despite the limited karyological data available for the genus *Echimys*, the low 2n = 66 of *M. didelphoides* does not correspond to the high diploid numbers in known *Echimys*, and falls within the range of other genera such as *Mesomys* and *Isothrix*. This low 2n represents another character supporting the separation of *E. armatus* (= *M. didelphoides*) from *Echimys*, as proposed by the morphological studies of Husson (1978). The shorter tail, and the frequent lingual opening of the metaflexus in not very worn upper M1 or M2, are also diverging characters proper of the genus *Makalata*.

Patton and Reig (1989), in their study of electromorphic variation in Echimyidae, did not include *Echimys* specimens. Nevertheless, they showed that *Isothrix* and *Makalata* are closer to one another than to *Mesomys*, and that these three genera form a diverging clade from terrestrial *Proechimys*. Karyological evidence supports this view and also suggests that *Makalata*, *Isothrix*, and *Mesomys* form a separate group within the subfamily Echimyinae.

More recently, Lara et al. (1996) published a valuable analysis of relationships between echimyids based on cytochrome b sequences. Their results supported the divergence of terrestrial *Proechimys* and *Trinomys* from arboreal echimyids. They also show a clade including *Echimys chrysurus*, *Nelomys* cf. *brasiliensis* and *Makalata didelphoides*. The monophyly of *Echimys chrysurus* and *Nelomys* cf. *brasiliensis* is well supported (bootstrap value 96). *Makalata*, however, is only marginally supported as sister taxon to *Echimys* + *Nelomys* (bootstrap value 57). Clades including *Makalata* and *Isothrix*, *Mesomys* or *Dactylomys* have even lower bootstrap values. The contradiction between this DNA sequence results and karyologic and electromorphic evidence requires further studies of DNA sequences based on additional samples and other species of *Echimys* and *Nelomys*.

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